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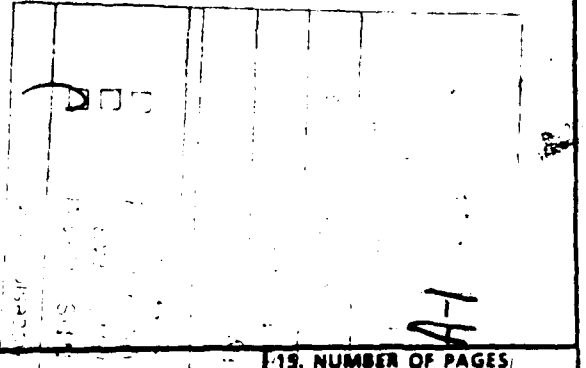

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REAL TIME STATISTICAL SIGNAL PROCESSING*

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Abstract. We use the phrase "statistical signal processing" to emphasize that unlike what is traditionally called digital signal processing, the operations we perform are dictated by the application of some optimization criterion. Such an approach often suggests appropriate 'macro' building blocks for implementing the optimal solutions.

Therefore, there are two major aspects of real time statistical signal processing:

I: Determining optimal algorithms

II: Implementing the optimal algorithms.

We should try to have some interaction between these two aspects:

implementation considerations being able to influence the form of algorithms,

and

the nature of the algorithms being able to suggest the form of implementation.

Moreover, for real-time and adaptive operation, we need to be able to do both I and II

quickly: with "FAST" algorithms,

recursively: to easily incorporate new data,

cheaply: perhaps with special chips.

We shall show that the generic problem of computing innovations for a second-order stochastic process can be approached in a form that allows us to nicely blend these several desiderata. We shall also illustrate the application of these results in two applied problems--adaptive line enhancement in sonar and adaptive echo cancellation in telephone channels.

The basic theoretical results arise from using our concept of displacement ranks (a measure of how far from stationarity a given process is) to extend to nonstationary processes the by now well-known lattice filter structures used for prediction of stationary stochastic processes.

We shall show how to extend the concept of 'reflection coefficient parametrization' to non-stationary processes and thereby obtain realizations of the innovations and prediction filters as a cascade of J-orthogonal lattice sections.

We shall indicate how these structures can be used to realize general signal processing filters using VLSI circuits.

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